FloodSAFE CALIFORNIA

Flood Damage and Life Risk Analysis

Risk and Economics Analysis Session

Technical Workshop #2:

Tools and Data for Measuring Progress Toward Achieving the Basin-Wide Feasibility Studies and Central Valley Flood System Conservation Strategy Objectives

October 24, 2013

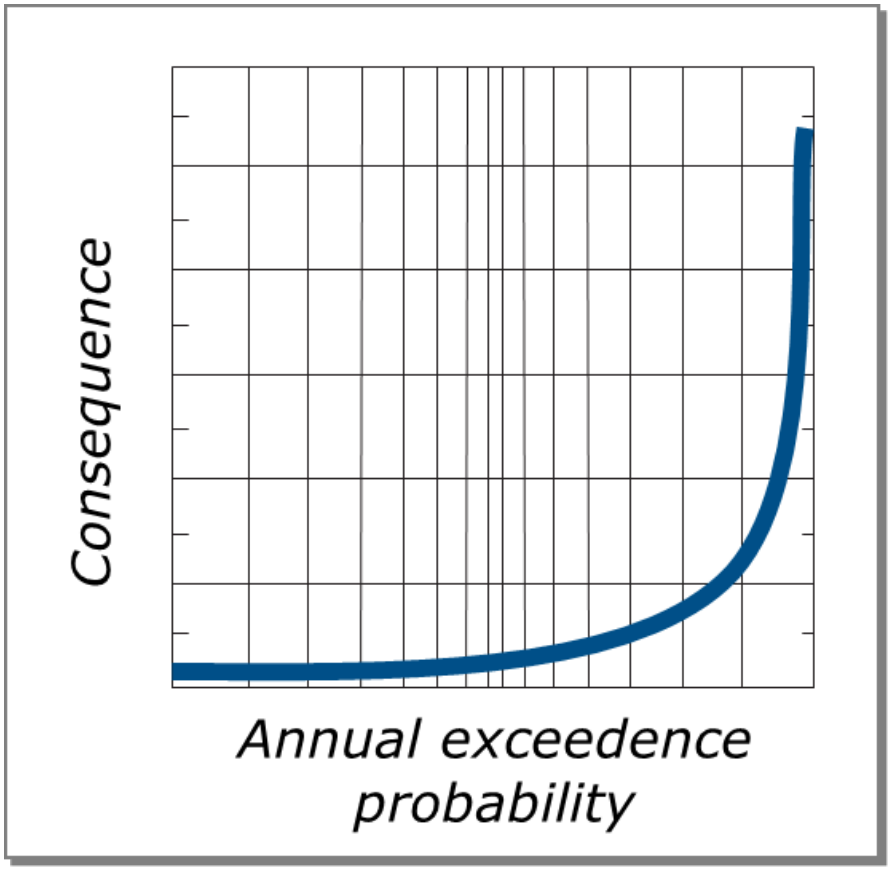
PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY

San Joaquin BWFS Planner

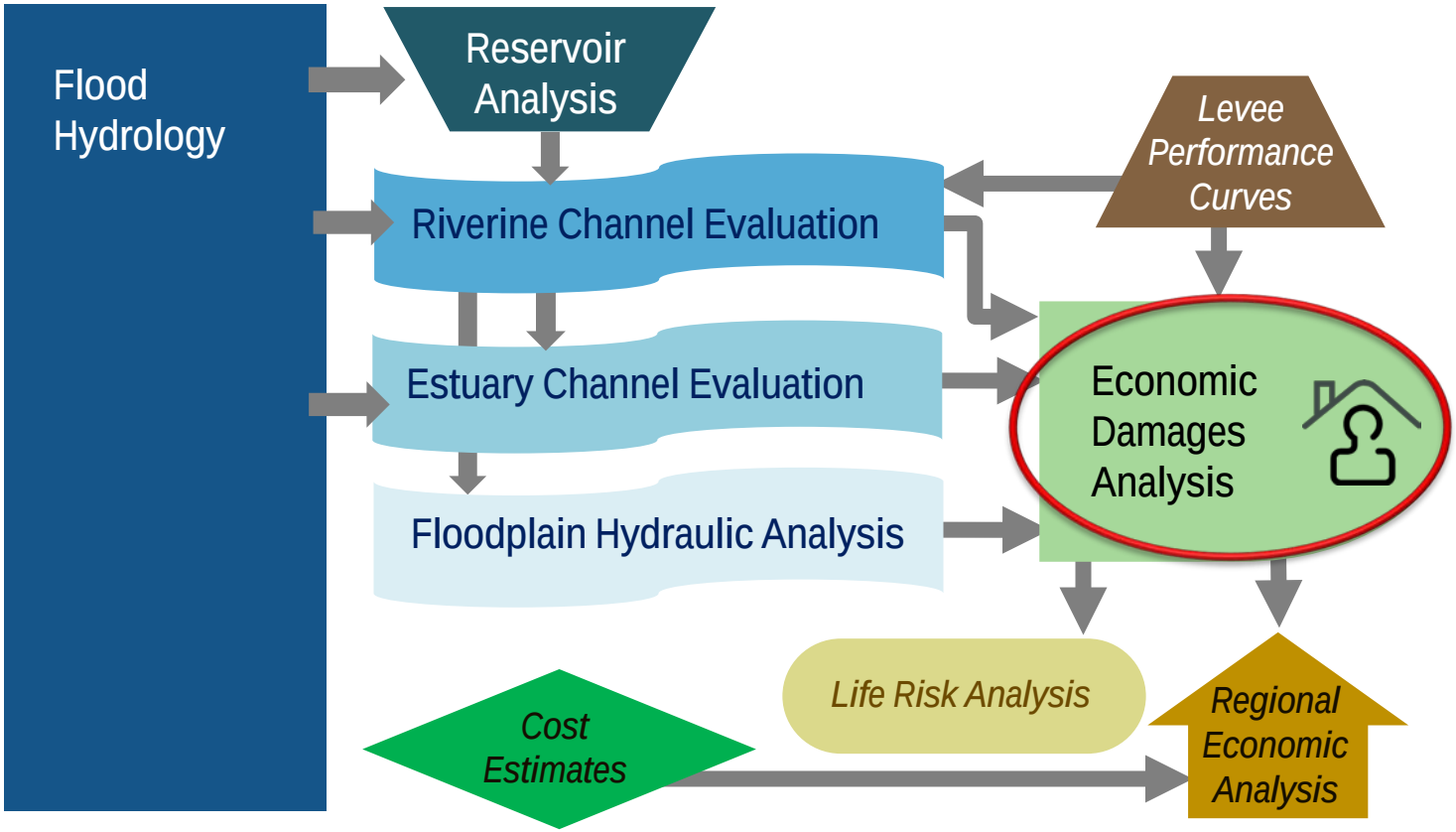
By Day…

…HEC-FDA Modeling Superhero **in his dreams**

Flood Risk

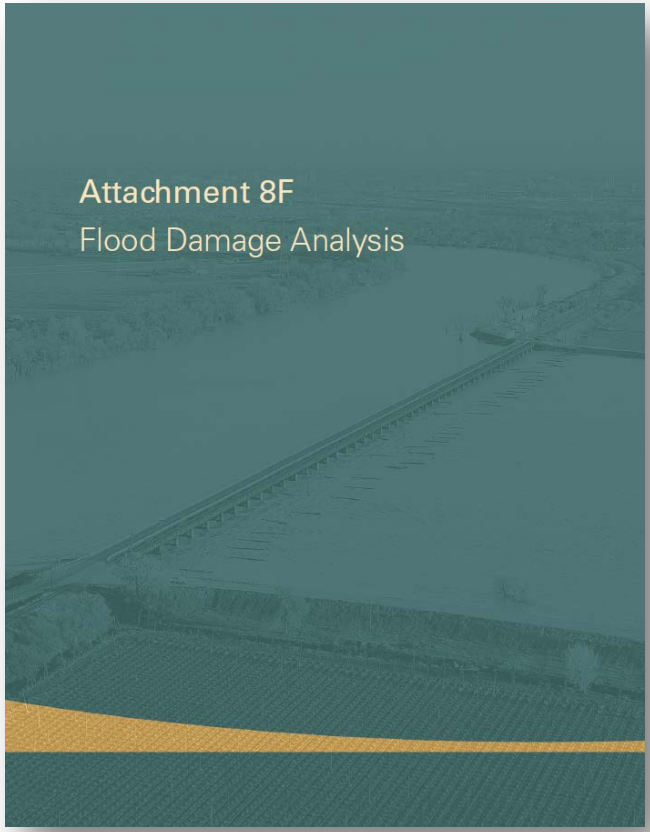


Systemwide Analysis Tools & Data



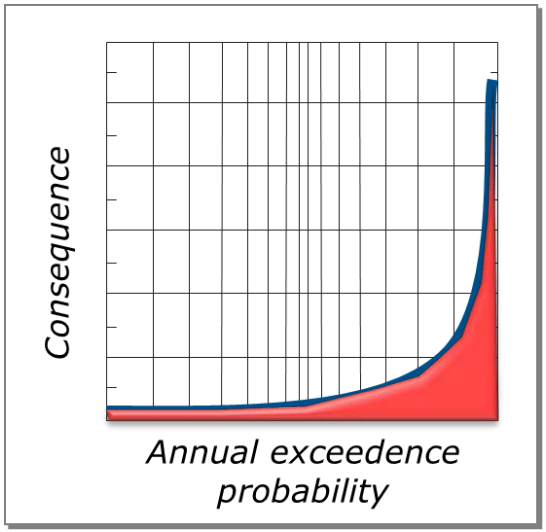
Purpose of Flood Damage Analysis

- Estimate potential tangible flood damages to determine flood risk reduction:
  - Structures
  - Contents
  - Crops
  - Business losses



Flood Damage Analysis Outputs

- Expected Annual Damages (EAD)
  - Annualized damages from periodic flooding

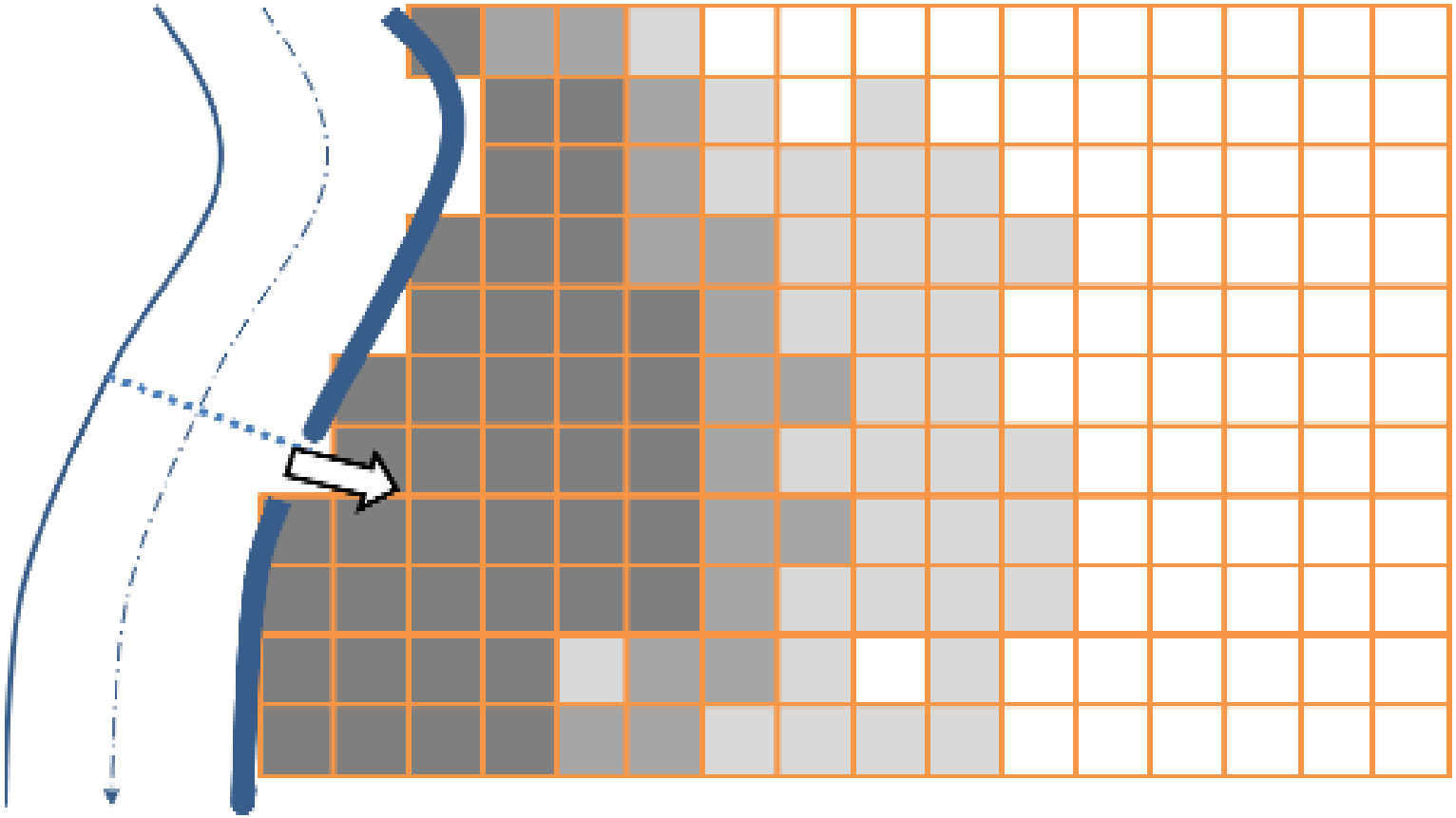


- Annual Exceedence Probability (AEP)
  - Likelihood of being flooded in a given year

Link to Objectives and Metrics

Objective	Metric
People and Property at Risk	Annual probability of flooding
	Damages to property, crops, and infrastructure
	Number of small communities with 100-year level of protection
Flood System Flexibility	Ability to achieve the above under alternative future conditions
Flood System Resiliency	Reductions in economic damages with added resiliency measures in place
Consistent and Efficient O&M Practices	Improved system performance or reliability

HEC-FDA Conceptual Framework



HEC-FDA Inputs and Outputs

Economic inventory
- Structure data
- Crop data
- Damage assumptions

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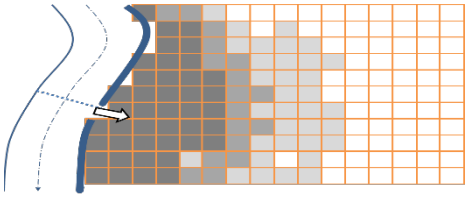
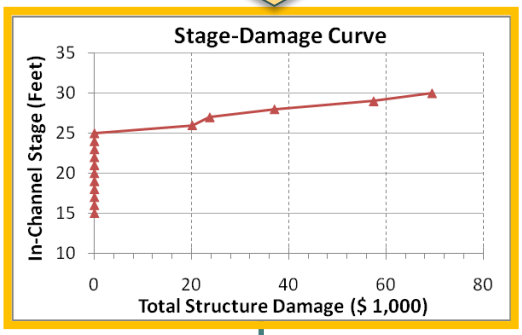
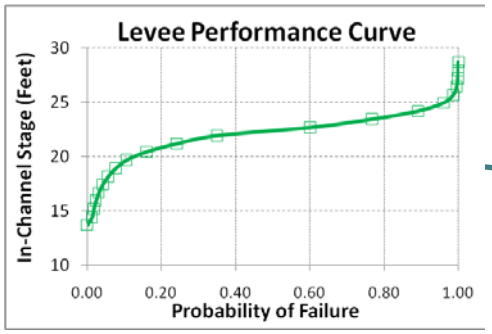
Floodplain
- depth grid

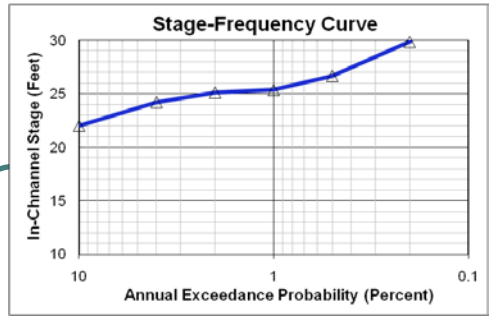




Levee Evaluations



Hydraulic Results

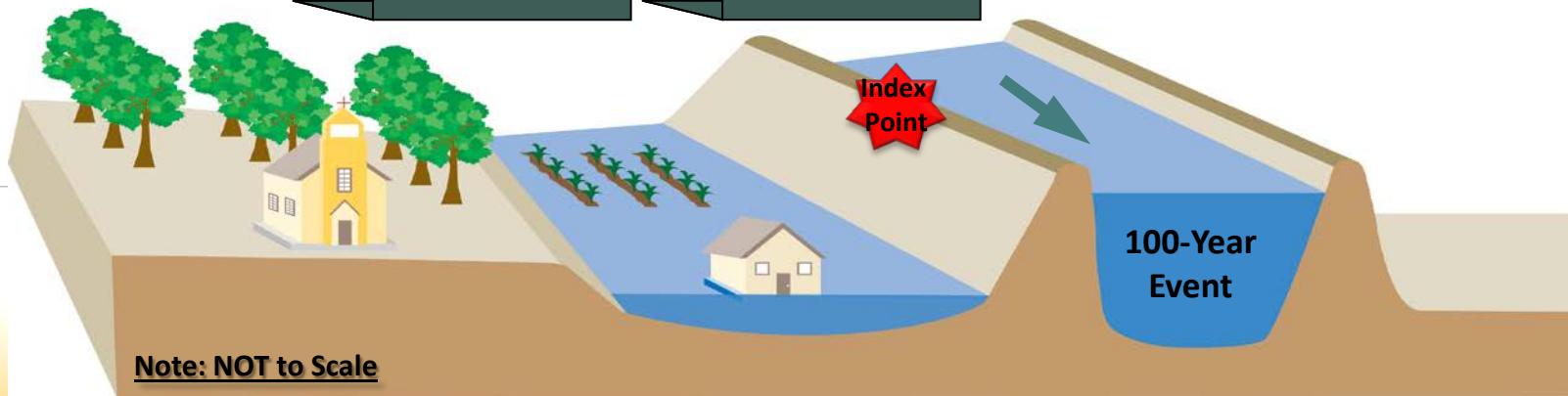


HEC-FDA Monte Carlo analysis

Input data uncertainties

Expected Annual Damage (EAD)

Annual Exceedence Probability (AEP)



Note: NOT to Scale

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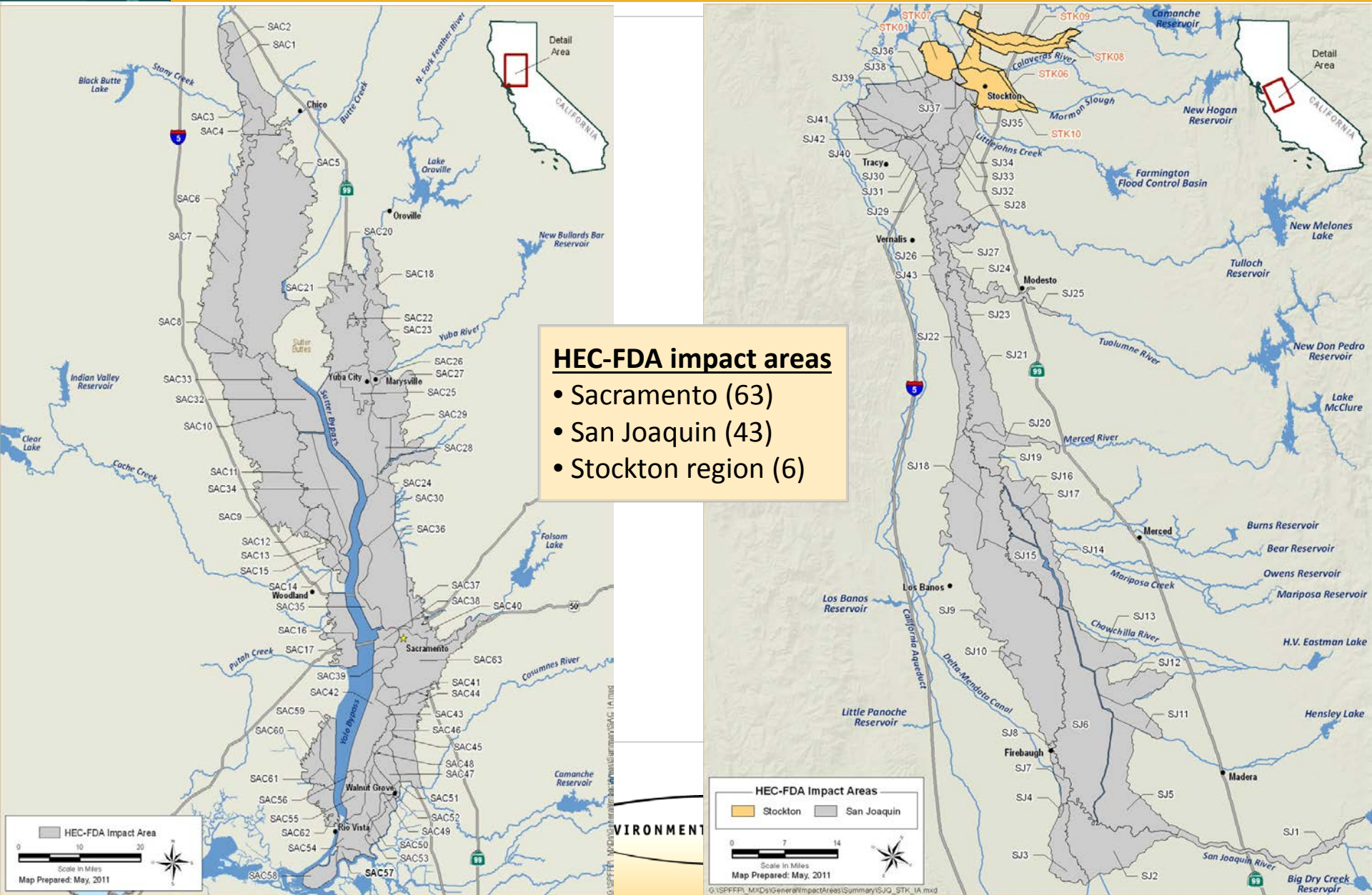
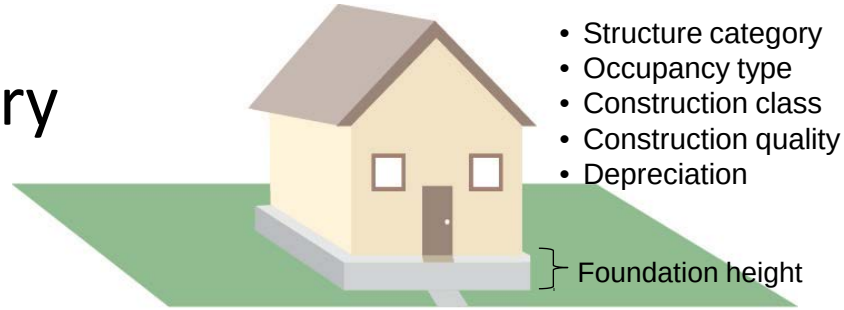
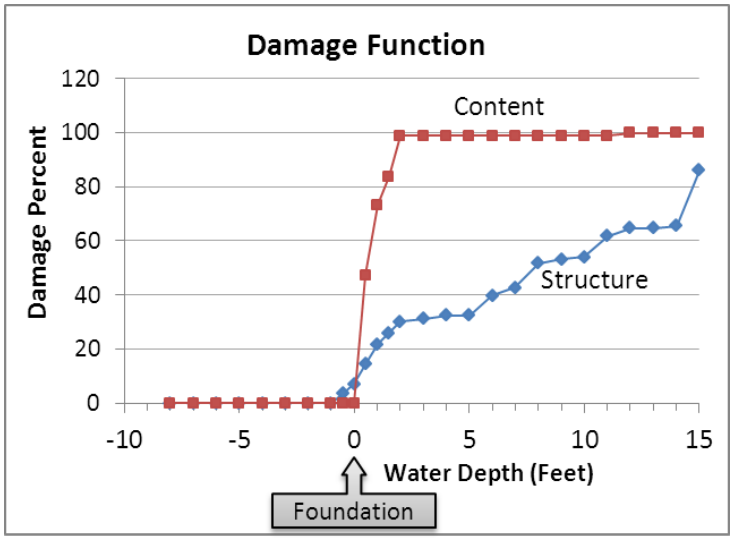
CVFPP HEC-FDA Impact Areas



HEC-FDA Inputs: 2010 Structure Inventory

- Update the structure inventory from the Comp Study
- Parcel data: 2010 June ParcelQuest
- Updates: reconnaissance-level field surveys
- Estimated value: structural characteristics

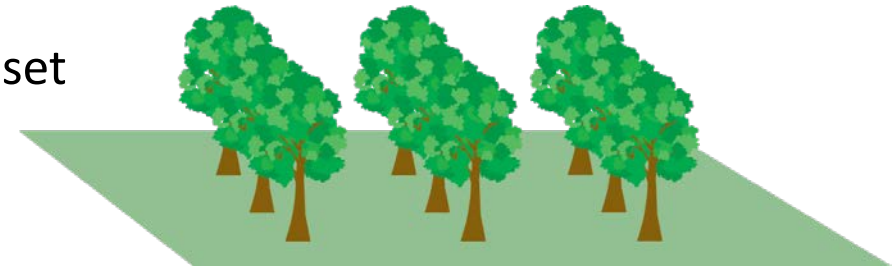




HEC-FDA Inputs: Crop and Business Losses

Crop

- Acreage: 2010 DWR GIS landuse dataset
- 117 DWR agricultural land uses -> 20 crops
- Data preprocessed in Crop Damage Spreadsheet



Business Losses

- Estimate economic output per day for non-residential structures
- Estimate temporary business interruption days

Overview of HEC-FDA Modeling

Economic inventory
- Structure data
- Crop data
- Damage assumptions

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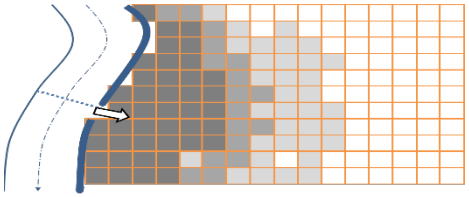
Floodplain
- depth grid



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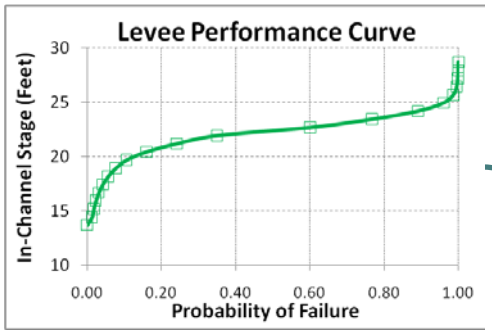

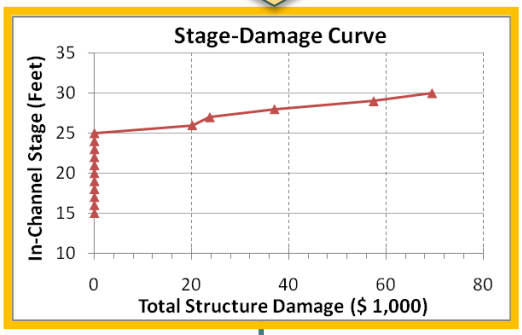

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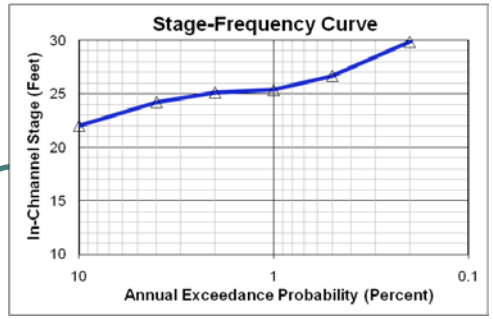
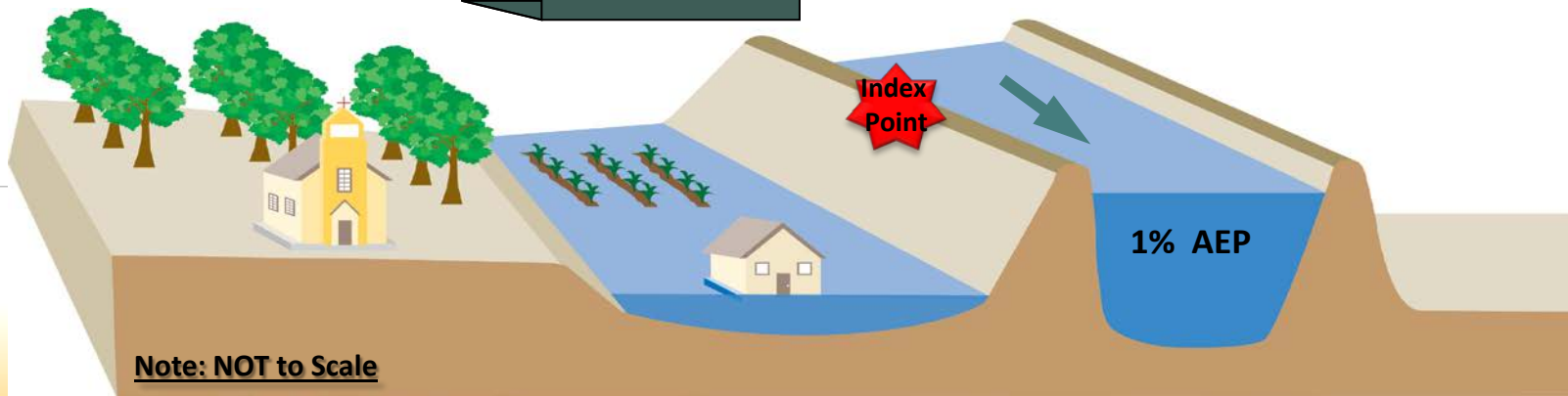


HEC-FDA Monte Carlo analysis

Input data uncertainties

Expected Annual Damage (EAD)



Note: NOT to Scale

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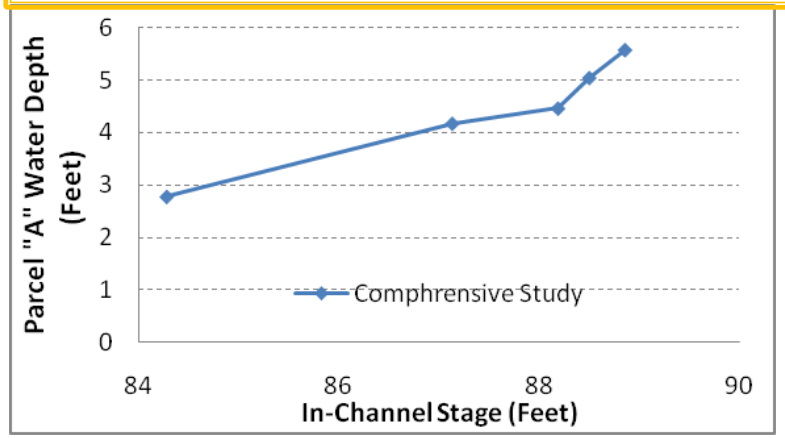
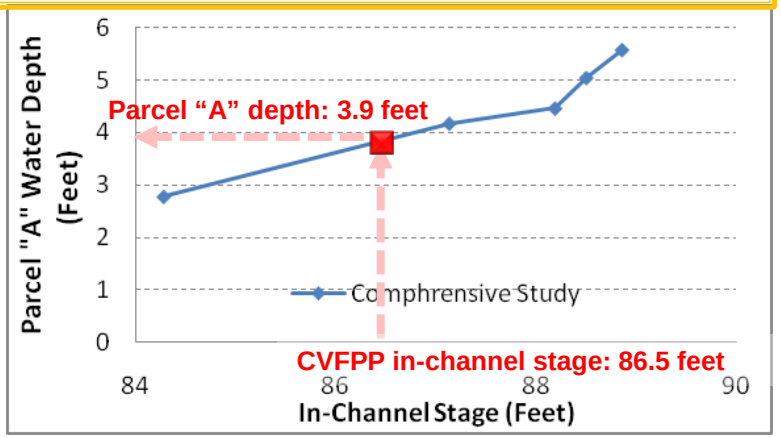
HEC-FDA Inputs: Floodplain Depth Grid

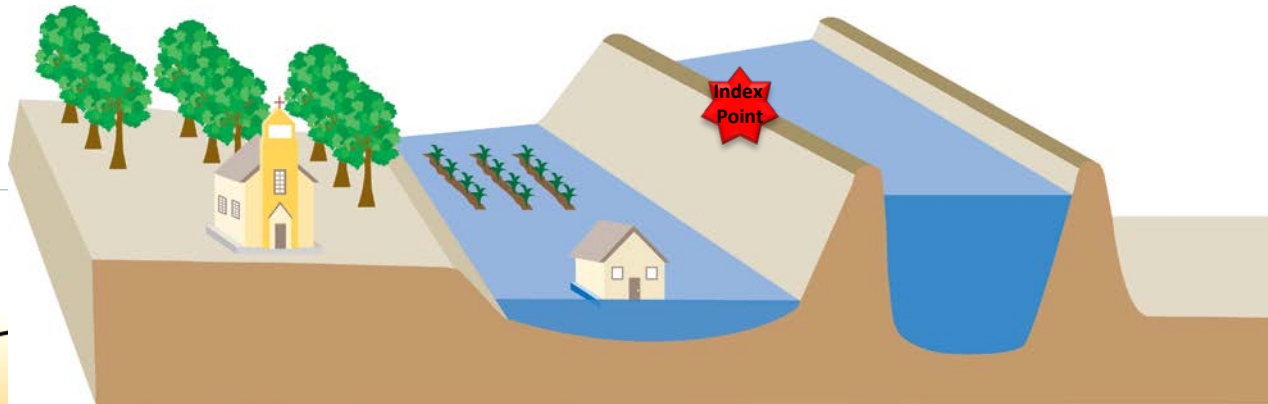
- **Source #1**: Floodplain model (RMA Delta Model/FLO-2D)

- **Source #2**: Derived from Comp Study FLO-2D depth grid

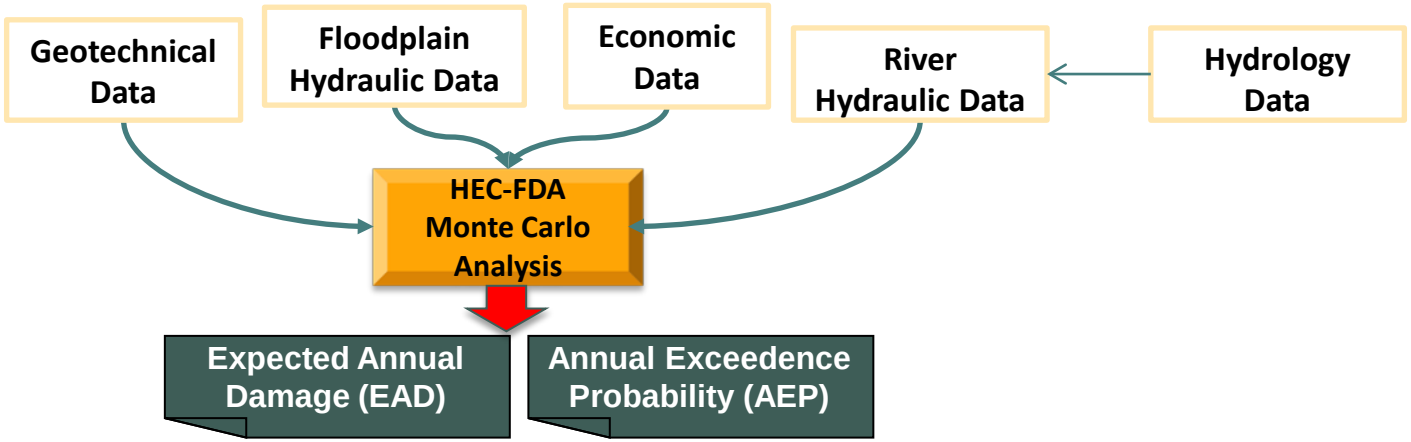
Key Assumption:
Depth of flooding in each impact area is directly related to river stage at a single index point.

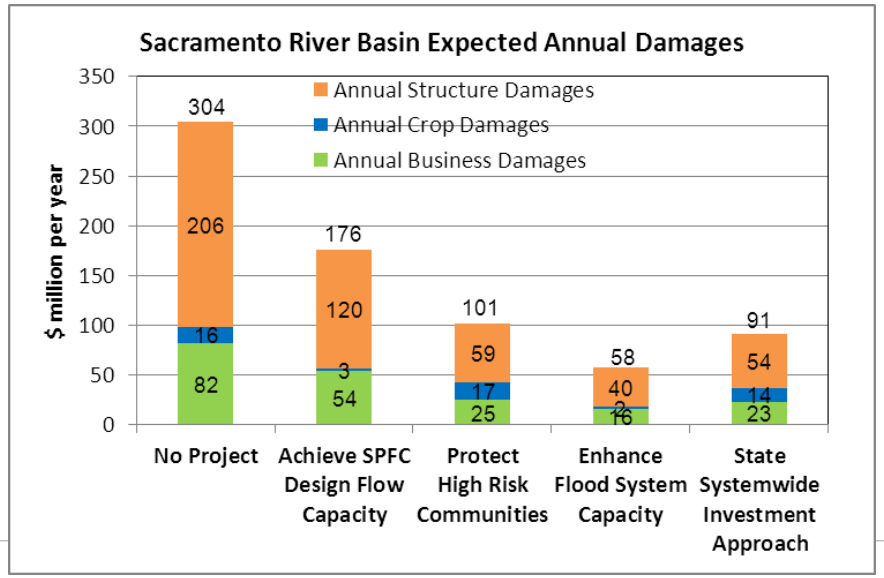


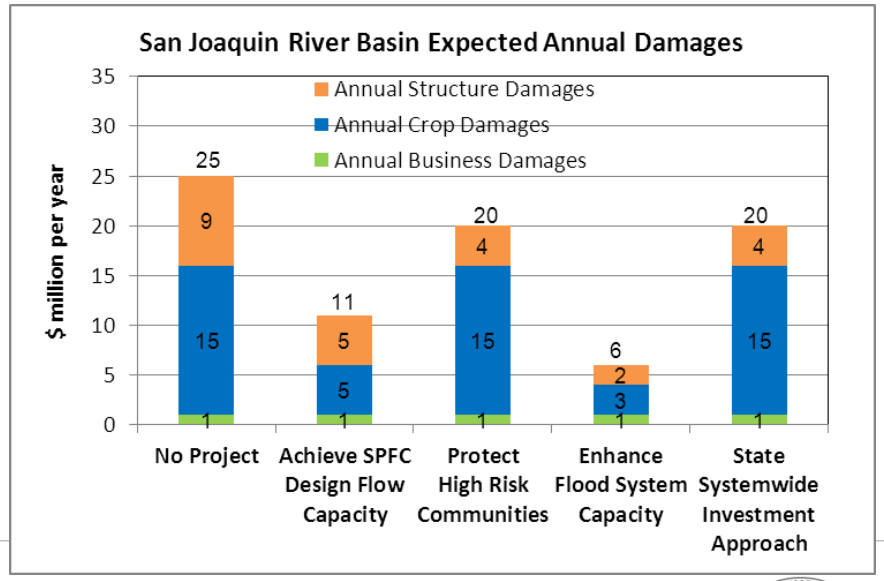




Flood Damage Evaluation: Results







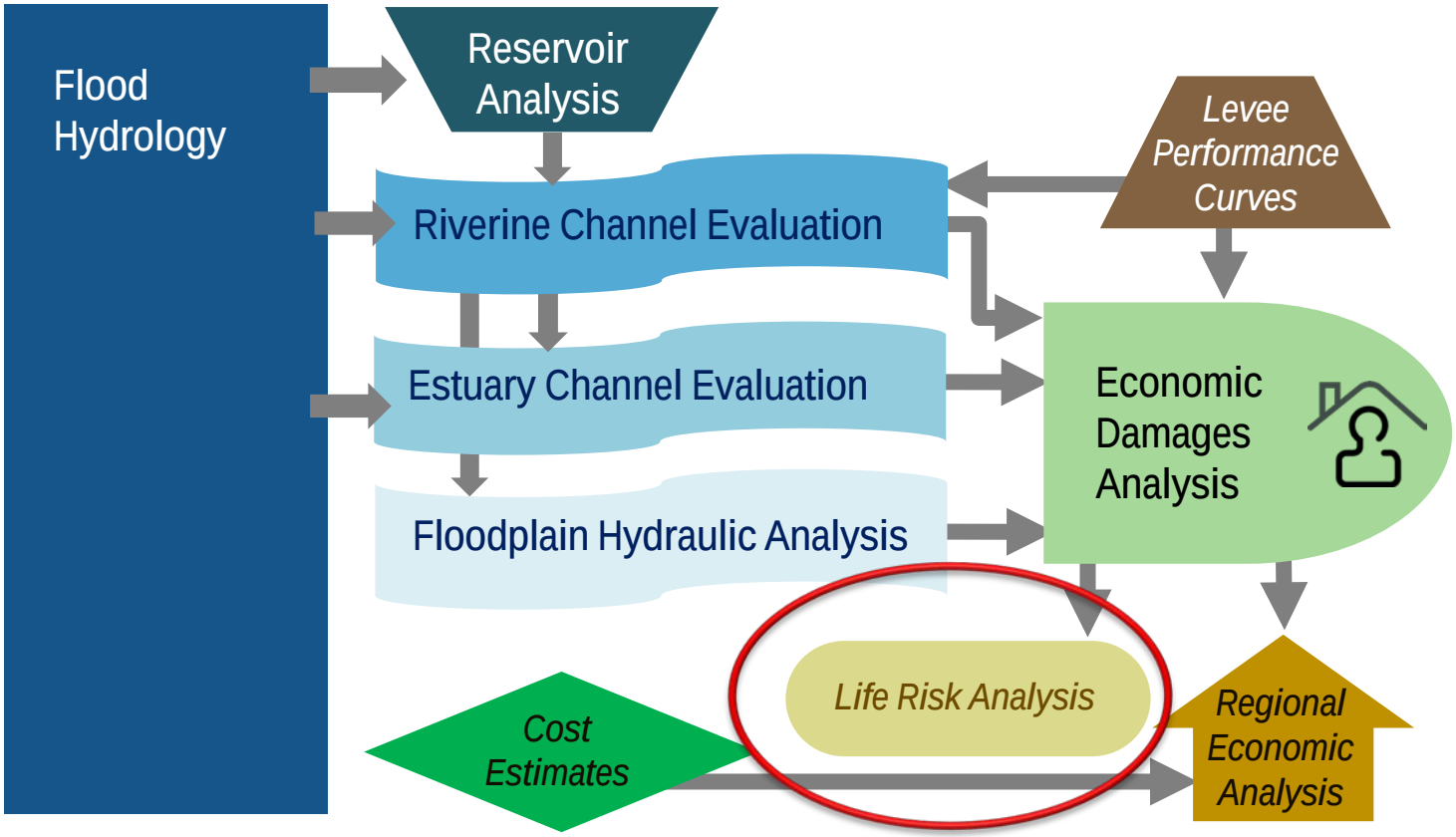
Flood Damage Analysis Enhancements

- Will apply new hydrology (CVHS) and hydraulics (CVFED) models
- Updated the 2010 structure inventory, focusing on high value properties
- Incorporated considerations of other tangible flood damage categories:
  - ✓ Vehicles damages
  - ✓ Roads damages
  - ✓ Post-disaster emergency and recovery costs

Flood Damage Analysis

Questions?

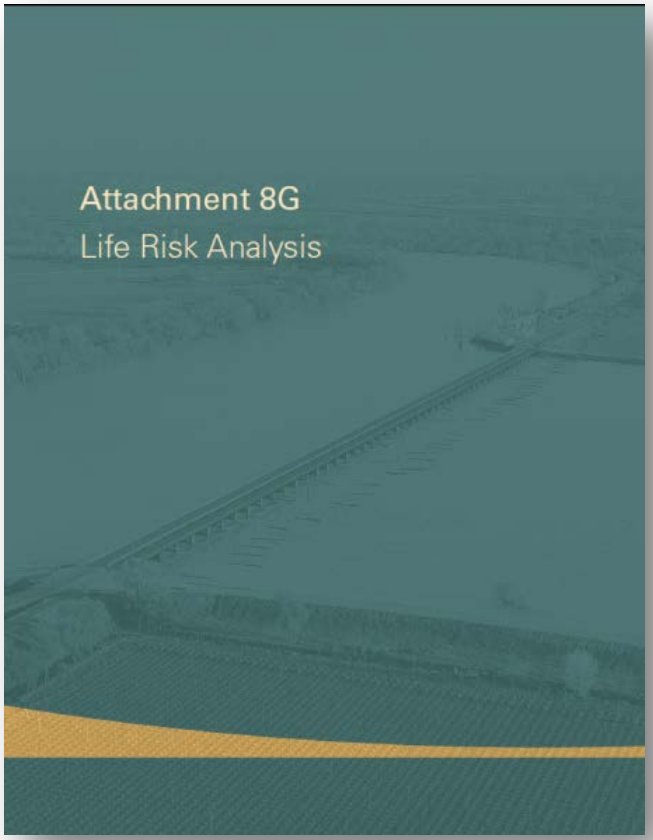
Systemwide Analysis Tools & Data



Life Risk

Needed a method that:

- Systematic, reproducible, and defensible
- Based on reasonable science
- Relies on empirical data
- Relies on readily available data
- Applicable systemwide



Link to Objectives and Metrics

Objective	Metric
People and Property at Risk	Risk to human life, health, and safety
Flood System Flexibility	Ability to achieve the above under alternative future conditions

HEC-FDA Inputs and Outputs

Economic inventory
- Structure data
- Crop data
- Damage assumptions

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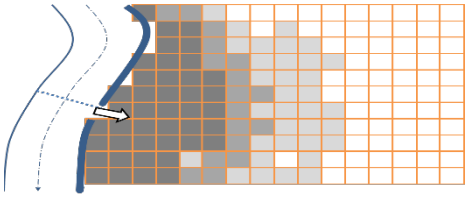
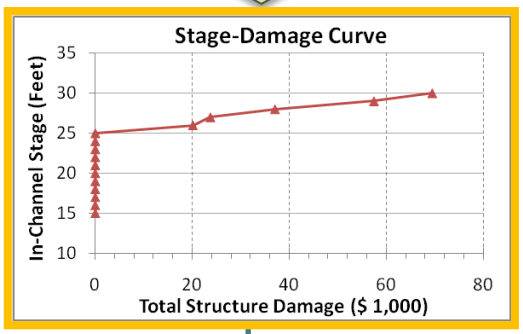
Floodplain
- depth grid





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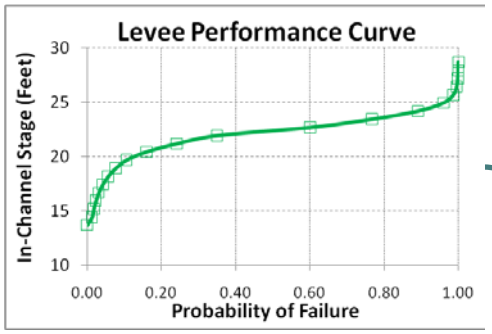

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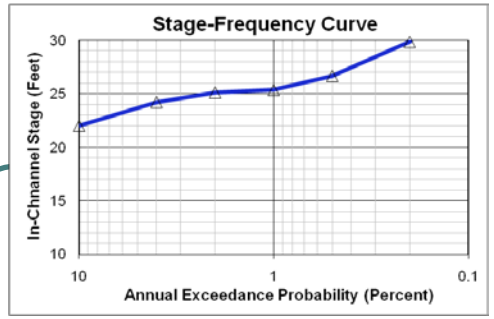
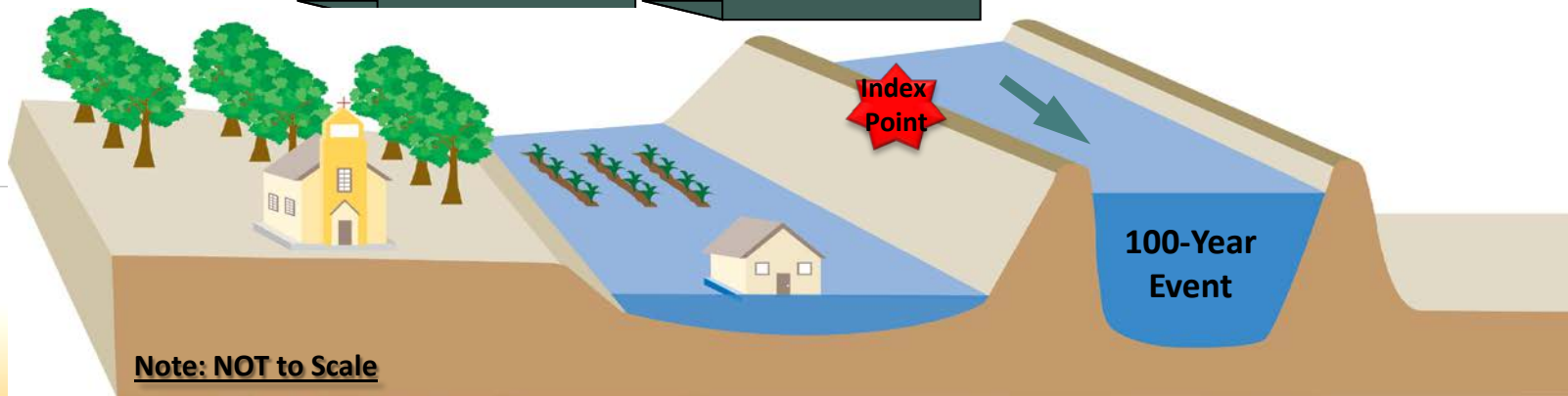


HEC-FDA Monte Carlo analysis

Input data uncertainties

Expected Annual Damage (EAD)

Annual Exceedance Probability (AEP)



Note: NOT to Scale

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HEC-FDA Inputs and Outputs

Inventory
- **Population at Risk**

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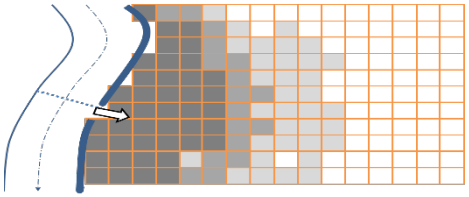
Floodplain
- depth grid



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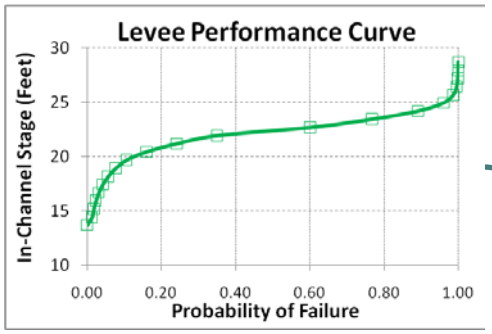

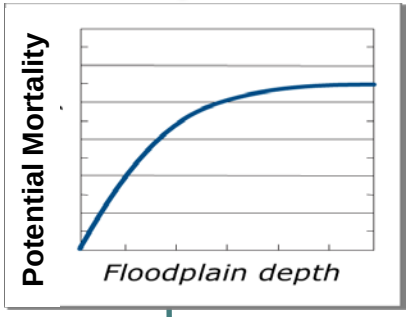

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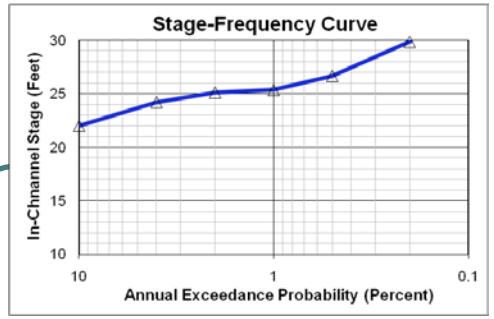
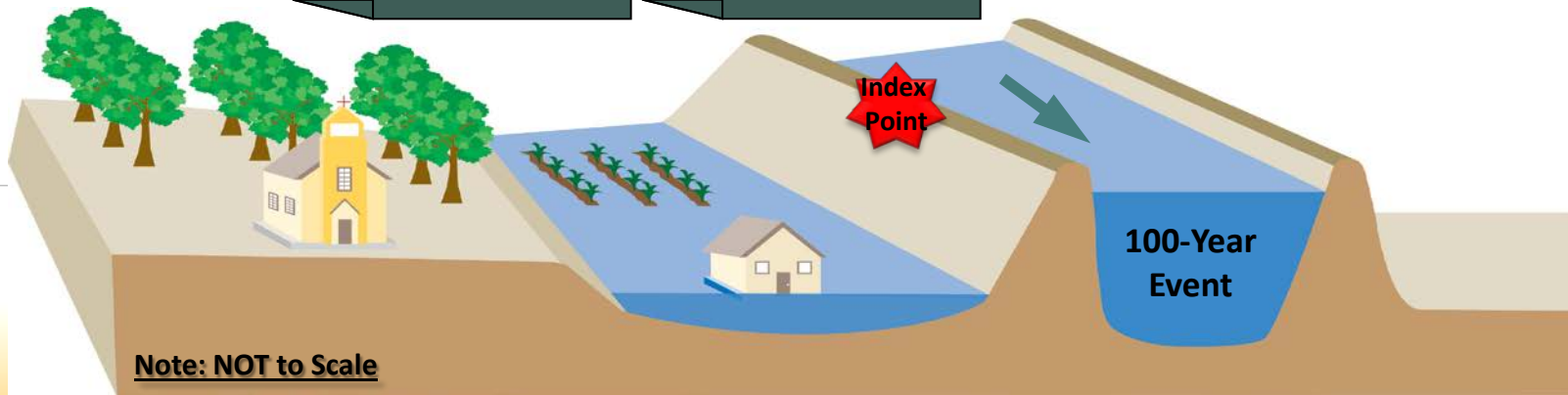


HEC-FDA Monte Carlo analysis

Input data uncertainties

Expected Annual Life Loss

Annual Exceedance Probability (AEP)



Note: NOT to Scale

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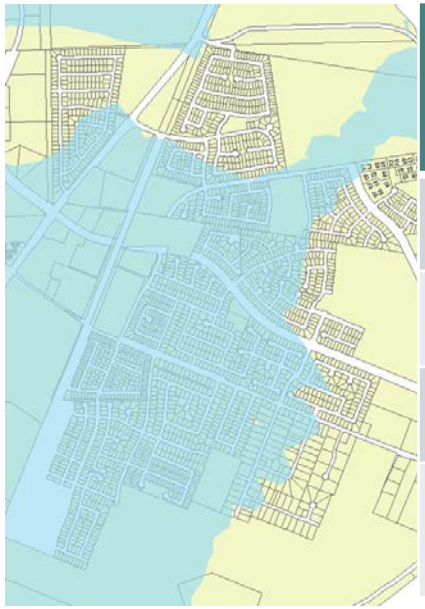
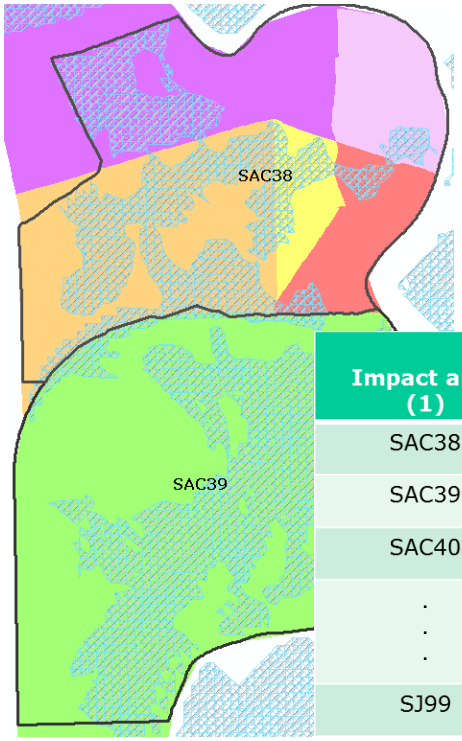
Exposure

- Replaced structure value with population



Parcel ID (1)	Value of property ($1,000) (2)
046-491-005-000	165.83
046-491-004-000	150.97
046-492-008-000	217.21
. . .	. . .

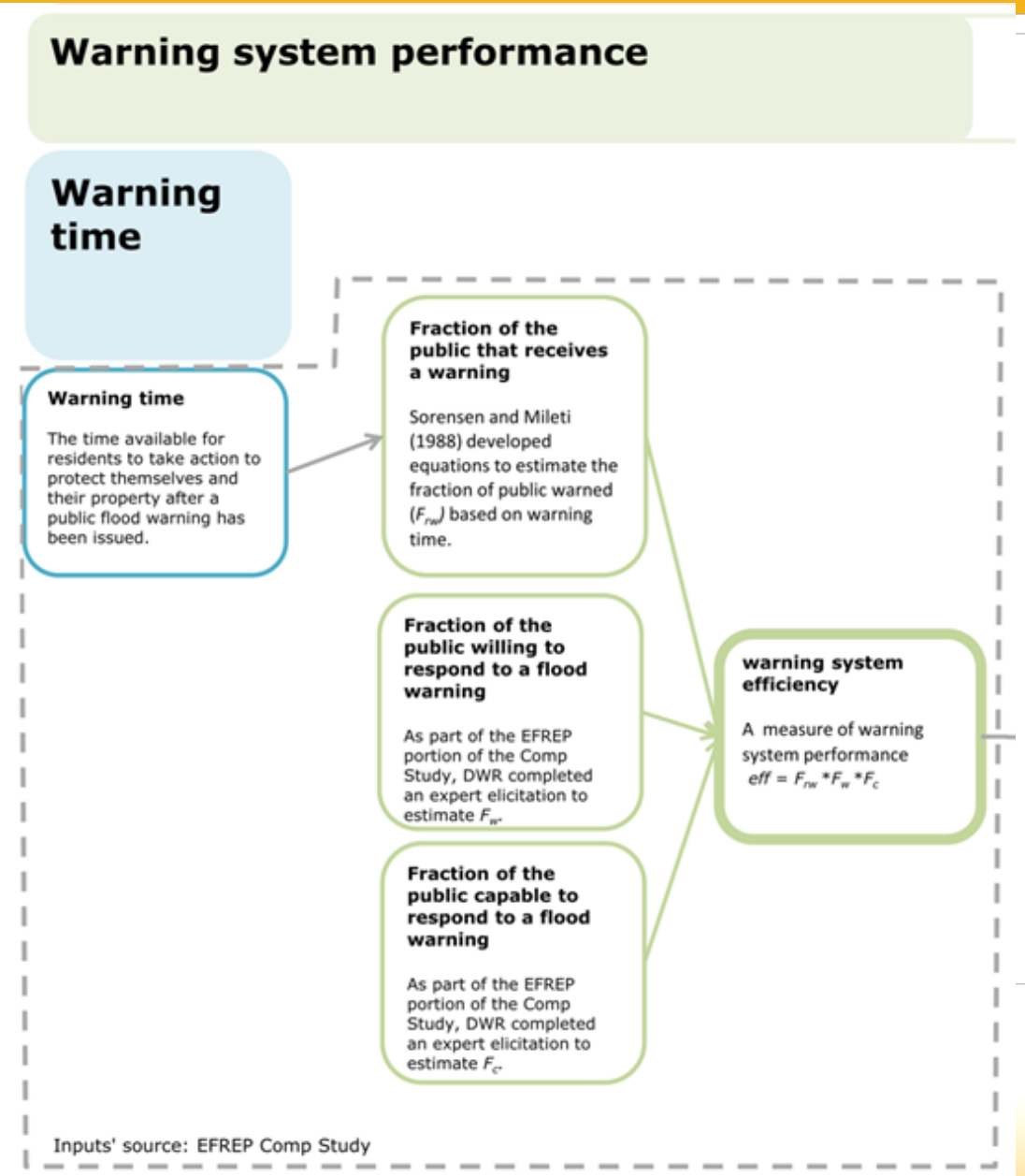


Impact area (1)	Population in floodplain (2)
SAC38	91644
SAC39	789797
SAC40	7217
. . .	. . .
SJ99	12565

- Estimated number of people for each structure in each impact area using 2000 Census Data

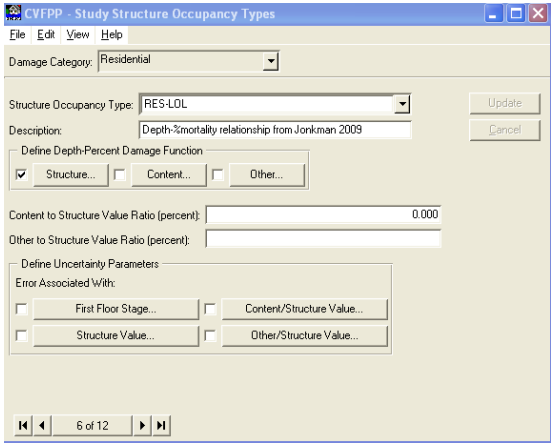
Exposure

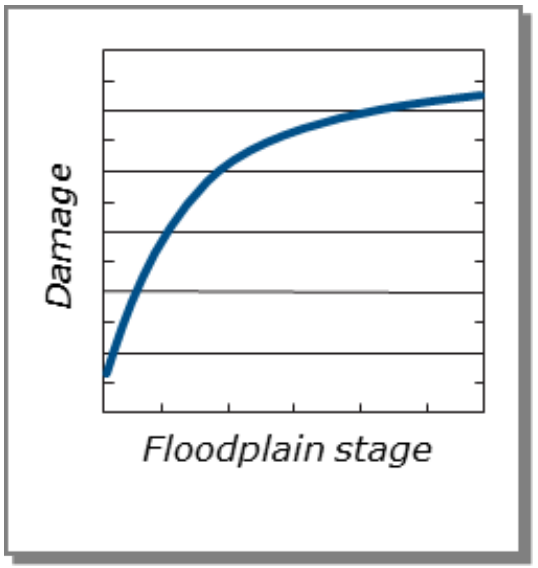
- Accounted for evacuation using warning system performance

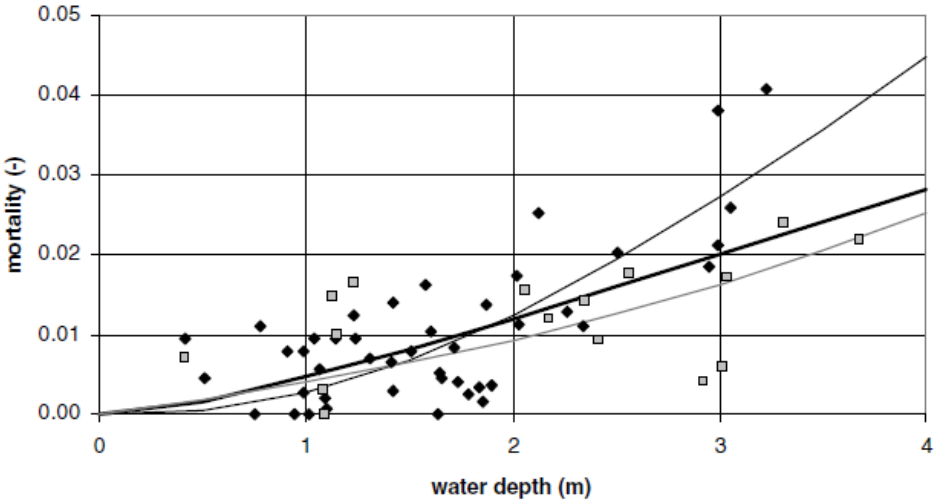


Vulnerability

- Replaced depth-damage function with depth-%mortality function







Jonkman (2009)

Potential Life Risk Analysis Enhancements

- Update depth-% mortality functions
  - Use age thresholds for ability to evacuate
  - Consider horizontal and vertical evacuation
- Update US Census information
- Update flood warning times (for evacuation estimates)
- Consider time of day that flooding occurs
- Use updated flood hydrology and hydraulics models

Life Risk Analysis

Questions?